Data and Information Needs

- Preamble
- Collection
- Use
- Management
- Research

Data Needs Working Group: Preamble

- Data form a central and dual role as indicators of ecosystem performance, while providing a vehicle to inform the complex models necessary to evaluate tradeoffs associated with management decisions, I.e., gaming or MSE approaches

- EAF-EAM objectives must evolve through interaction and dialog between science and management. We must avoid the false dichotomy of prioritizing based on science vs. management vs. governance needs (i.e., avoid modeling for management vs. modeling for tenure)

- Data needs that support ecosystem approaches are more than the simple sum of single species information, including protected and high value species, and socio-economic issues. However, EAF/EAM data requirements are not necessarily different

  - among the fundamental issues may be emergent, conservative properties of ecosystems (e.g., properties of the system differ from properties of the parts)

  - there are known big data monitoring gaps

- Business as usual probably won't provide what we need, but there is no need to reinvent the wheel with respect to needs for data sharing, common research objectives, and regional considerations. Eg. There are existing models like the NSF LTER/LMER Program which requires some data collections common to all ecosystems, but also relies heavily on locally-adapted, process-oriented studies that are ecosystem-specific

Data Needs Working Group: Data Collection

- We must begin this process with an assessment of what data exist, and use this to help identify data needs and limitations. Finite resources prompt us to examine the relevance and efficiency of existing monitoring programs and data resources

  - **We must prioritize data needs both for near and long-term efforts (these may differ) with complex, multiple objectives**

  - **Expand data back in time through collaborative efforts designed to get better records on ecosystem performance from an historical perspective**

  - **EAF-EAM questions and multiple modeling efforts should be used to guide data initiatives; objectives for science and management should be the basis for these questions. This will require a balance between formal hypothesis testing and time series monitoring**

  - **Design new studies with consideration of what is necessary for MSE and policy decisions, and supplement monitoring using intense process studies. Science-based adaptive approaches should be developed to help identify key unknown drivers**

  - **Focus on variability in space/time and life history**

  - **Process-level feedbacks need to be considered in selection of data streams**

Data Needs Working Group: Data Uses

- Data perform the central role of moving our efforts from theory into practice. As such, their use provides the foundation for all that we have discussed in the workshop. These include, but are not limited to:
  - Development of functional relationships
  - Description of human dimensions and socio-economic indicators and relationships
  - Development of biological indicators and reference points
  - Recognition of spatial and/or temporal contrasts
  - Development of science based adaptive approaches
  - Development of EIS guidelines for data analysis, and community impact assessments, etc.
  - Many others

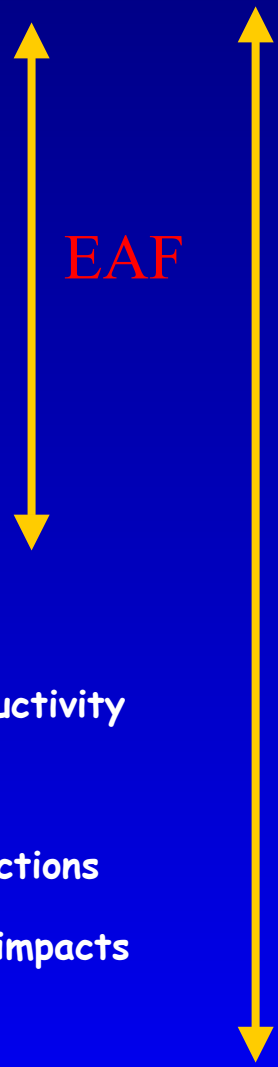
- As an organizing tool, we offer the following matrix:

Data Needs Working Group: Data Management

- Data management for EAF-EAM will require a more comprehensive approach
- The system must be flexible enough to accommodate data from a variety of sources including long-term monitoring, short-term experiments, inventories of existing data, etc., all with extensive formal metadata documentation and quality assurance and quality control protocols. However, there is again no need to reinvent the well, as programs such as LMER/LTER (NSF) have established methods to do this
  - GIS should be a portal into the database management system (DMS) because of the role of, and need, for visualization
  - The system should contain multiple portals of access depending upon the intended use of data, but confidentially rules will necessarily need to be appropriately imbedded in the system
  - The DMS should be developed with a common vocabulary and metadata documentation designed to enhance multidisciplanary use
  - The DMS should include models and model outcomes
  - The DMS should allow multiple products and outputs that are accessible at different levels of resolution

Data Needs Working Group: Hot Research Topics

- By-catch/by-product/fishery interactions and tradeoffs
- Trophic interactions, total ration and diet changes
- Habitat-fish and habitat-fishery interactions
- Taxonomy and stock ID
- Consequences of physical variability
  - Low-frequency
  - High-frequency
  - episodic
- Life history/ontogeny
- Consequences of climate change, regime shifts
- Eutrophication/habitat alterations/inherent ecosystems productivity
- Social/economic dimensions
- Carrying capacity/lower trophic level and forage base interactions
- Spatial contrasts that reveal processes under differing use impacts
- Spatially explicit processes



Synthesis of Science Needs for Supporting Ecosystem Approaches

Scope	EAF	*<<boundaries are fuzzy>>*	EAM
example	technical interactions species, fleets		spatially explicit ecosystem interactions
Data-Information Needs	complicated		complex
Dynamics	simple, linear		complex, non-linear
Indicators	stock catches, status of stocks		maintenance of ecosystem services and processes
Social Science Role	tradeoffs, consumer producer surplus		multiple 'currencies', non-market valuation
Bio-organization	Stocks	guilds	aggregate processes
Governance	Multiple Fisheries stakeholders		Multi-Sectoral Regional

The following slides contain supporting information

Social Sciences Discussion: Major points for the Working Group

- Human dimensions indicators need to be better integrated into ecosystem approaches. Economic agents a critical element of ecosystem structure. High priority value indicators, to what extent are the important attributes captured by them? MSE models critically dependent on econ/social metrics. Behavioral adaptations, preferences of human sub-groups important as emergent issues. Functional feeding relationships have similar properties between fish and people. Predicting behavioral responses is key element in MSE evaluation.
- Policy objectives much broader that EAF, EAM debate is critical. Communication between social and natural sciences critical, but does not necessarily imply we need complex models incorporating both. Optimization of yields in USA system where tradeoffs in EAF are balanced.
- Priority of economics in policy setting, not an afterthought. Modeling the management system may be helpful to know the scope of governance decision.
- How should people-oriented indicators be selected? Performance indicators - Ecosystem structure/function vs. "wellness" of a particular issue. Observe what people do. Policy analyses articulate tradeoffs. Consider in advance.. Transitional costs of achieving ecosystem objectives. Scale problems in selecting indicators. Some indicators may be required under various statutes.
- Valuation systems, intergenerational, discounting, green accounting.
- Importance of outreach, communication, education in governance system.
- Ecosystem-based projections with behavioral adaptations more realistic than F-sased ss projections. Larger-scale societal issues influence regional ecosystem drivers (e.g., demand for fish). Aquaculture vs. wild fisheries.

Modeling Discussion: Major points for the Working Group

- Modeling of ecosystem effects has been incremental and adaptive, many model types are derivative of single species population dynamics with elaborations for ecosystem issues of increasing complexity. Need to explore sets of models – can use multiple models looking at differing mechanisms & scenarios. Structured systems to evaluate multiple hypotheses explaining outcomes requires different models, in a formal adaptive management approach
- Management strategy analyses imbed population and ecosystem dynamics within the management system. What are appropriate inference procedures for the selection of likely model structures? Information criteria for "goodness of fit". Bayesian model weights, evidence ratios. Qualitative error checking on structure of model. Within models such as Ecosim have uncertainty measures.
- Benefits of MSE are in the modeling process (collaboration), assess tradeoffs, decision Makers have to be transparent regarding "rules". MSE provides results that can be quantitative, directional, semi-quantitative or qualitative. Selection of indicators should be in the context of what people are interested in. Objectives turned into quantitative performance indicators. Argues that the modeling process should be with stakeholders and iterative/adaptive. Uncertainty increases up the quantitative scale (direction, levels, absolutes). Understanding behavioral responses of people to management is an important aspect of MSE (implementation error). Who is allowed to be a "stakeholder" in the MSE process? Who determines this? Specifying objectives & performance measures is major part of process. Random Utility models. Social science models.
- Model selection process-appropriateness table.
- Optimality vs. Satisficing, tactical vs. strategic levels. Interactions with existing laws – MSY vs. optimality..Minimum sustainable winge? Mgt. Strategies robust to different strategies for optimality. Transition costs from tactical approaches to strategic ecosystem approaches. At what point do management decision tradeoffs occur (before modeling qurg quantitative outcomes?) Feedback "open-loop" or "closed loop"?
- Consider habitat effects in model selection Modeling to increase knowledge with life history information as opposed to using minimum (engineering) approaches that describe history. Ecology key to informing Models, merging ecosystems modeling and EAF modeling. Relevant models from non-traditional disciplines? Ensemble analysis for combining multiple models. Role of optimization. Finance literature alternative ways of specifying uncertanties, Fuzzy logic, network analyses. Non-parametric models

Data Needs Discussion: Major points for the Working Group

- Data needs supporting ecosystem approaches are more that the sum if species, information, protected species and socio-economic. EAF issues of importance include trophic interactions, total ration and diet changes. Habitat, fishery interactions, life history. Climate change and nutrient loading. Social/econ dimensions. Expand data back in time to get better perspectives on ecosystem health, need long time series to develop contrasts. Expand capabilities in taxonomy and stock ID. Focus on interactions monitoring and research.
- EAF-EAM models should be used to guide data initiatives – objectives for management should be basis. What is necessary for MSE, and policy decisions? To good good science to make better MSE? Collaborative setting of objectives, science develops models and indicators developed, tested, for sensitivity. Fundamental issue is emergent, conservative properties of ecosystems. (e.g., properties of the system differ from properties of the parts). Top-down data collection hypothesis driven, multiple models drive data collection. Focus on variability in space/time/ontogeny. Process-level feedbacks need to be considered in selection of data streams. Balance between formal hypothesis testing and time series monitoring. Science based adaptive approaches to help identify key unknowndrivers. Known big data monitoring gaps. Data mgt. Plan for monitoring,interactions, inventory and historic. Ecosystems require DMS more so than ss. Complex systens analysis.
- Collaborative approaches to data scavenging and collection. Need an assessment of what is there – data qa/qc. Finite resources means need to revisit existing Monitoring programs, sometimes revisit monitoring using intense process studies. Data/information needs should be locally dapted. Priority setting for complex systems with multiple objectives. Business as usual won't necessarily provide what we need, spatial contrasts may reveal processes under differing use impacts.
- EIS process provides guidelines for data and analysis, community impact assessments. Prioritize information now, future interaction between science mgt. Need dialog False dichotomy to prioritize based on science or mgt. needs. Note EAF/EAM requirements are different. Boundary issues are important in data priorities.
- Data models (open, collaborative, sharing) must support governance system. Data matrix according to models